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Purchase of LISST In-Situ Laser Diffraction Particle Sizer(s) for Sediment Transport and Biology Studies

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13. ABSTRACT *(Maximum 200 words)*

For sediment transport studies, one describes the transport on a size class by size class basis as a function of vertical height. This requires the suspended sediment size spectrum as a function of depth and time. No *in-situ* instrumentation determines the full particle size spectrum, but the LISST (Laser *In-Situ* Sizing and Transmissometry) particle sizer, appeared to meet some of our observational needs. Three LISSTs were purchased and two mounted on our bottom boundary layer tripods. The third was retrofitted with a settling tube to make it a "LISST-ST." These LISSTs have been deployed at the LEO-15 site off New Jersey in the fall of 1995, and in STRATAFORM in the winter 1996 on the Northern California shelf. Finally, we studied the LISST's response to real sediments from various sites. The sediment was sieved to obtain various sized sediments and the LISST's response to each size class was observed. Also, quantitative calibrations were made to see if the LISST would integrate the total suspended sediment properly, and these results are currently being written into a paper.

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Standard Form 298 Back (Rev. 2-89)

Final Report: N00014-95-1079

Purchase of LISST In-Situ Laser Diffraction Particle Sizer(s) for Sediment Transport and Biology Studies

by
Drs. James F. Lynch and James D. Irish
Applied Ocean Physics and Engineering, WHOI

BACKGROUND: For sediment transport studies, one desires to describe the transport on a size class by size class basis as a function of vertical height above the bottom. This requires information on the velocity as a function of depth and time, and the suspended sediment size spectrum as a function of depth and time. No *in-situ* instrumentation is now available which allows the determination of the full particle size spectrum. Multifrequency acoustics can only give a coarse resolution measurement of the vertical size spectrum profile for larger sized sediments. Optical scattering can only give detailed particle size spectra for very fine sediments. Since a large amount of our research effort has been devoted to the studies of the full sediment transport problem (including bottom roughness, bedload and suspended sediment transport), we are continually looking for new instrumentation to augment our capability. With the development and commercialization of the LISST (Laser *In-Situ* Sizing and Transmissometry) particle sizer, it appeared that some of our observational needs would be met with this instrument. Therefore, to keep our research on the cutting edge, we utilized the DURIP funds and WHOI matching funds to purchase three LISST particle sizers.

Initially, our plan was to mount a LISST at about 1 meter above the bottom on each of our two bottom boundary layer tripods, and mount a third LISST with remote sensor head on one of the tripods with the head lower to make suspended sediment size measurements closer to the bottom. Therefore, three LISST-100 sensors were initially purchased from Sequoia Scientific as proposed. When it became evident that the commercialization of the remote sensor head would not available in the foreseeable future, we decided to order the settling tube option instead. Therefore, , one unit was retrofitted with the settling tube to make it a "LISST-ST." Therefore, we have two LISST-100s and one LISST-ST, with associated cables, connectors, laboratory power supply, etc.

USAGE: These instruments were integrated into our sensor suite and mounted on our bottom boundary layer tripods. We were able to get delivery of one LISST-100s fairly quickly which enabled us to deploy it at the LEO-15 site off New Jersey in the fall of 1995. It was mounted on a Sequoia Scientific tripod which was deployed beside our larger tripod with other LISST instruments deployed by Sequoia Scientific. The instrument ran the whole time and obtained information on the suspended particle size until bio-fouling blocked the optical path. This LEO-15 deployment was made in conjunction with the joint bottom boundary layer studies that we have been making at that site with Dr. Yogi Agrawal and Chuck Pottsmith of Sequoia Scientific (who make the LISST) and Dr. Scott Glenn of Rutgers University. Preliminary analysis of this data has been completed and was presented at Oceans '96 (Agrawal, Y.C., H.C. Pottsmith, J.

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Lynch and J. Irish, "Laser Instruments for Particle Size and Settling Velocity Measurements," Proc. of Oceans '96, 1135-1142, 1996).

After the delivery of the other two LISSTs, one was deployed as part of the ONR funded STRATAFORM program in the winter 1996 at 50 meters depth on the edge of the mud patch on the Northern California shelf where we expected a sandy bottom. One LISST-100 was mounted at 1 m above the bottom on the USGS Geoprobe with our Sector Scanning Sonar and Acoustical Backscattering Instruments, and used in conjunction with the standard USGS instrumentation on the tripod (current, optical backscattering & transmission, etc). Preliminary results from this deployment have been presented at the fall AGU meeting (Cacchione, D., D. Drake, J. Irish, J. Lynch, G. Tate and J. Ferreira, "Measurements in the Bottom Boundary Layer in 50-m Water Depth during STRATAFORM - Implications for Sediment Flux," invited paper, abstract published in EOS, (fall AGU meeting), 1996), and submitted to *Marine Geology* (Cacchione, D.A,., P.L. Wiberg, J. Lynch, J. Irish and P. Traykovski, "Estimates of Suspended Sediment Flux and Bedform Activity on the Inner Shelf off Northern California during STRATAFORM," submitted *Mar. Geol.*, 1997.) Further work utilizing the acoustical and optical backscattering observations in conjunction with the LISST observations are presently underway.

Finally, during the Spring of 1997, we had a visiting student (Rebecca Latter from Southampton University, UK), who conducted a study of the LISST's response to real sediments from various sites. The sediment was sieved to obtain various sized sediments (in ½ ø size steps) and the LISST's response to each size class was observed. Also, quantitative calibrations were made to see if the LISST would integrate the total suspended sediment properly. Rebecca summarized her findings in an internal report (required as part of her visiting student status) and this is currently being rewritten into a paper by Peter Traykovski to be submitted before the end of the year.

Finally, all three instruments are being deployed in November 1997 for 4 months as part of the continuing STRATAFORM observations of sediment transport and Eel river plume. Two will be on surface buoys to observed the particle size distribution about 1 meter below the surface in the plume, and the LISST-ST will be mounted on a bottom boundary layer instrument tripod in 40 meters depth to observe the bottom suspended sediment size distribution.

PUBLICATIONS Resulting from the equipment purchase to date:

Agrawal, Y.C., H.C. Pottsmith, J. Lynch and J. Irish, "Laser Instruments for Particle Size and Settling Velocity Measurements," Proc. of Oceans '96, 1135-1142, 1996.

Cacchione, D., D. Drake, J. Irish, J. Lynch, G. Tate and J. Ferreira, "Measurements in the Bottom Boundary Layer in 50-m Water Depth during STRATAFORM - Implications for Sediment Flux," invited paper, abstract published in EOS, (fall AGU meeting), 1996

Cacchione, D.A,., P.L. Wiberg, J. Lynch, J. Irish and P. Traykovski, "Estimates of Suspended Sediment Flux and Bedform Activity on the Inner Shelf off Northern California during STRATAFORM," submitted *Mar. Geol.*, 1997